CYCLIC STRESS ANALYSIS OF CERAMIC COATED GAS TURBINE SEALS

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Through the use of the Finite Element Method, the cyclic thermomechanical response of ceramic coated gas turbine parts is considered. The analysis includes temperature dependent elastic-plastic-creep material properties and cyclic thermal loads. To demonstrate the cyclic thermomechanical response, a ceramic coated outer gas path seal is studied. The analysis will estimate the significant residual stress field created by the cyclic thermal loads.

TABLE I.

| % YSZ/CoCrAlY:		100/0	85/15	70/30	40/60	MAR-M-50
material set #:		1	2	3	4	5
property	**temperature($^\circ$F)**					
density(lb/in^3)	all	.155	.180	.205	.254	.320
poisson ratio	all	.25	.26	.27	.28	.30
thermal cond. (BTU/min-in-$^\circ$F) ($\times 10^{-4}$)	0	4.09	4.09	4.09	4.09	422.98
	200	4.09	4.09	4.09	4.09	"
	500	4.09	4.66	4.98	5.38	"
	1000	4.33	6.26	7.46	8.35	"
	1500	4.74	8.51	10.60	12.20	"
	2000	5.70	11.64	14.85	17.66	"
	2500	8.11	16.30	20.95	25.52	"
specific heat (BTU/lb-$^\circ$F)($\times 10^{-2}$)	0	.126	.121	.116	.107	.097
	2500	.161	.161	.161	.158	.155
coef of expansion (in/in-$^\circ$F) ($\times 10^{-6}$)	0	4.08	3.28	3.36	3.64	6.40
	2500	4.83	7.70	8.38	9.52	12.20
Young's modulus (lb/in^2)($\times 10^6$)	0	6.90	3.80	5.15	8.30	34.70
	2500	2.00	2.00	8.00	17.75	15.60
tensile strength (lb/in^2)($\times 10^3$)	0	4.25	6.00	8.10	33.25	40.0
	2500	3.30	7.25	11.75	1.00	40.0
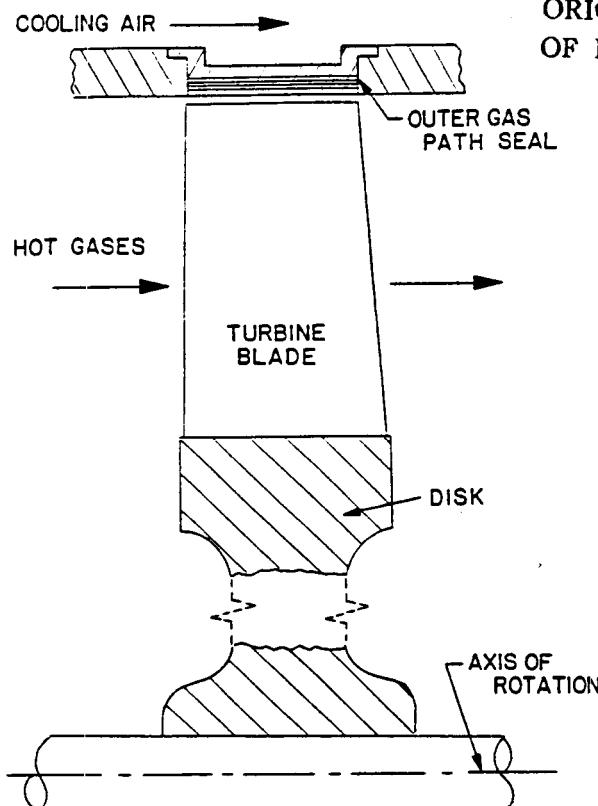
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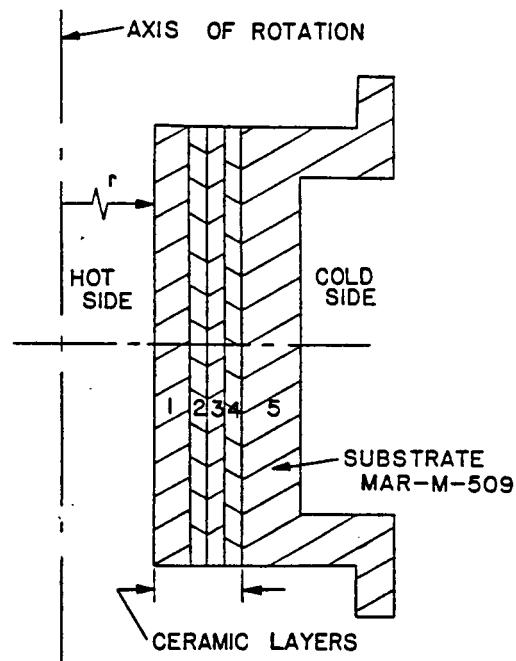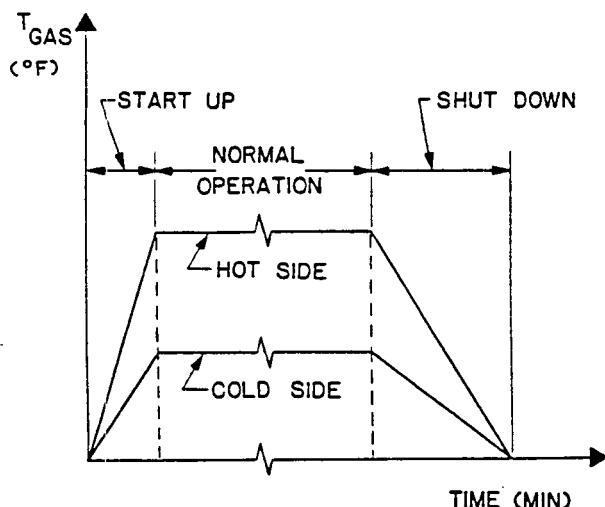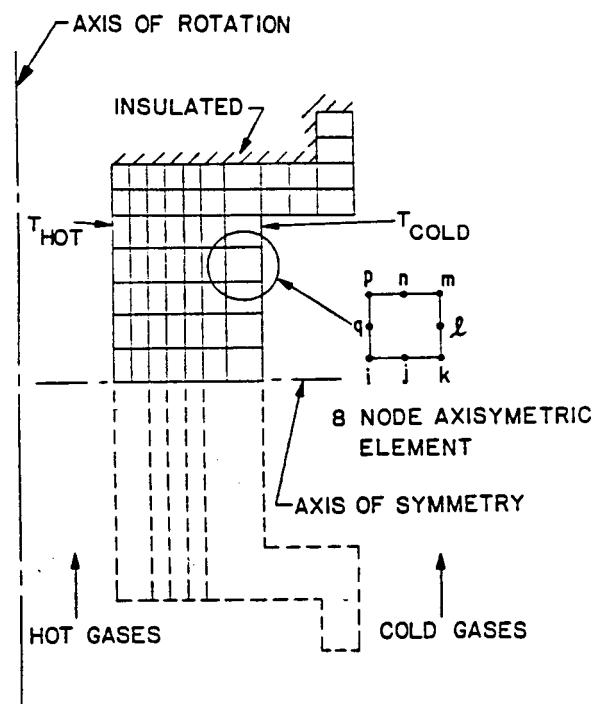
Figure 2.

Figure 3.

Figure 4.
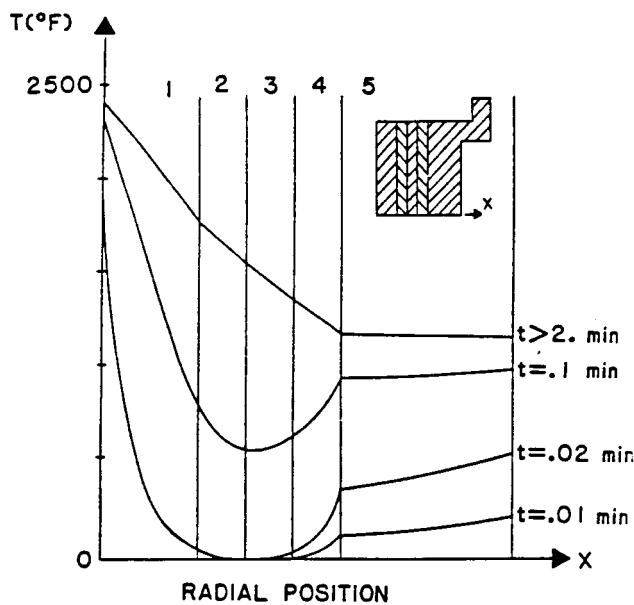
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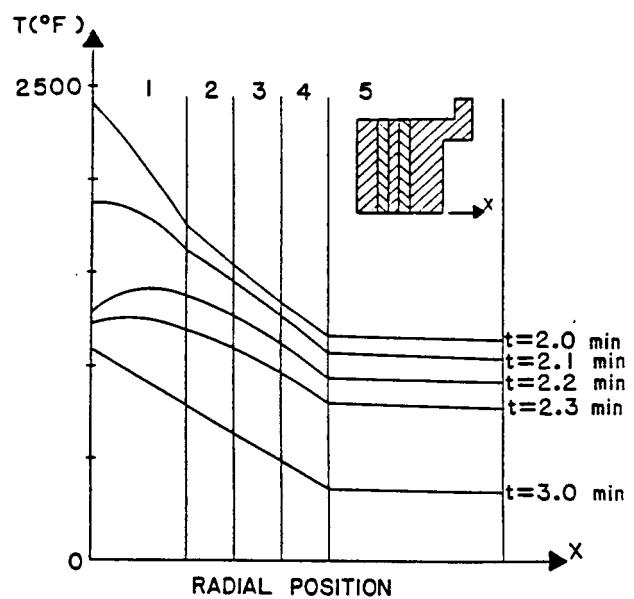
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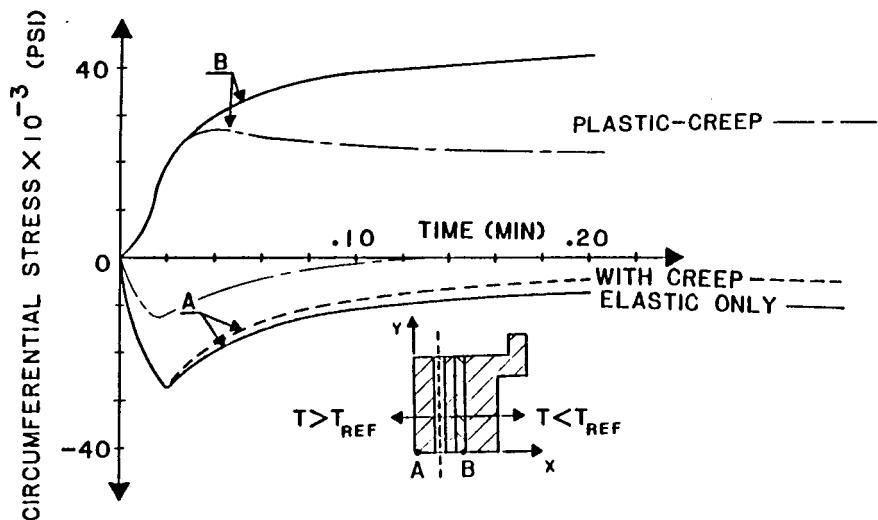
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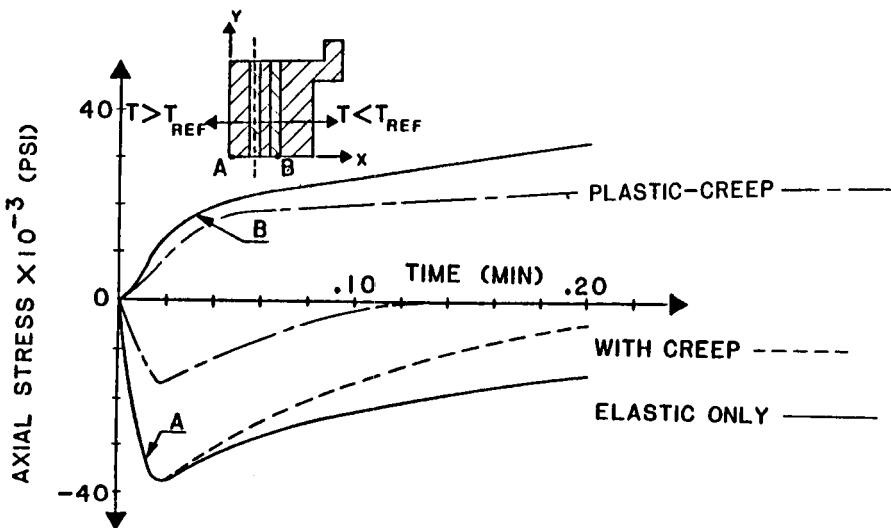
Figure 8.

Figure 9.

Figure 10.

PLASTICITY ZONES
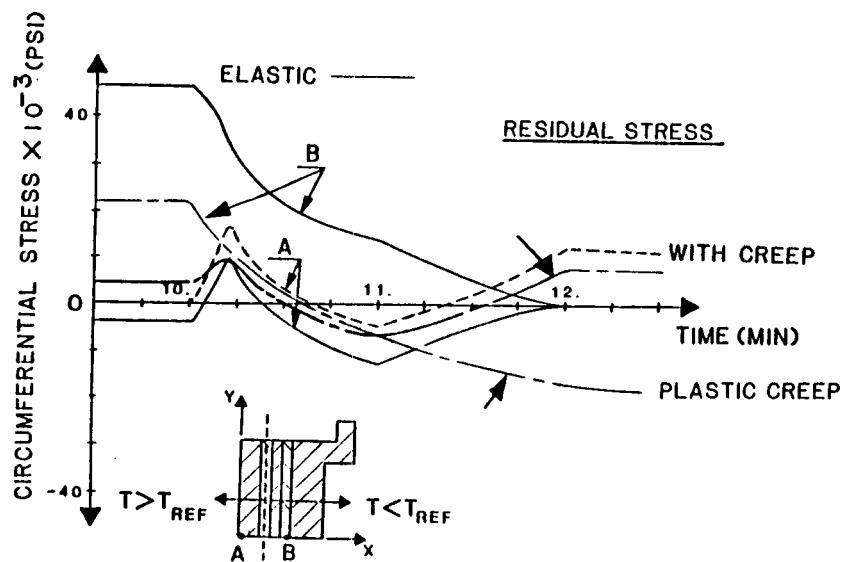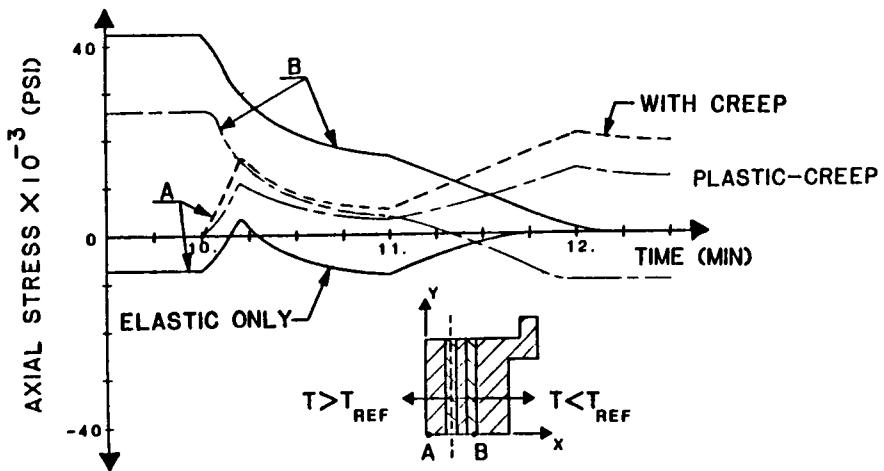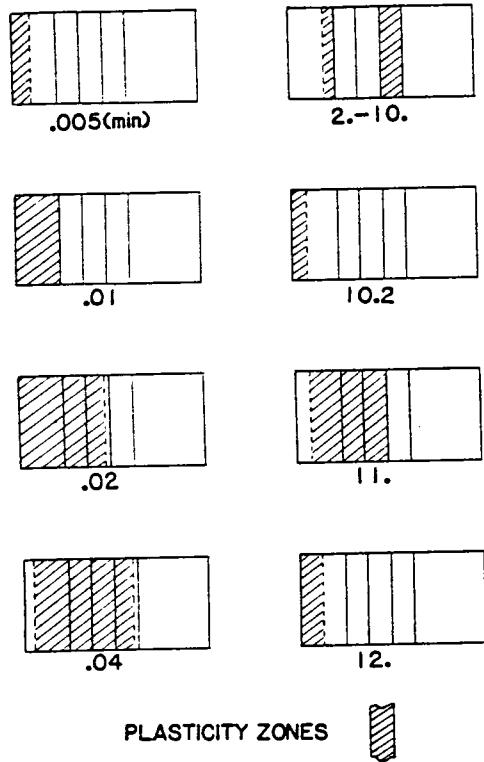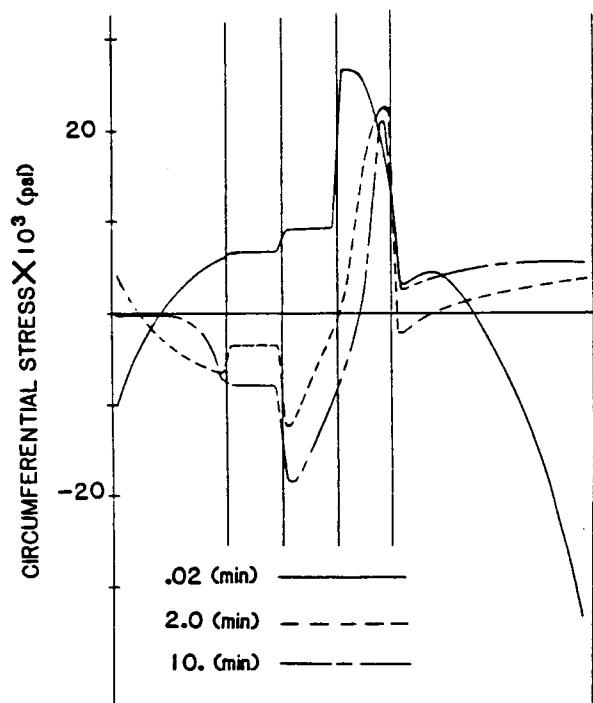
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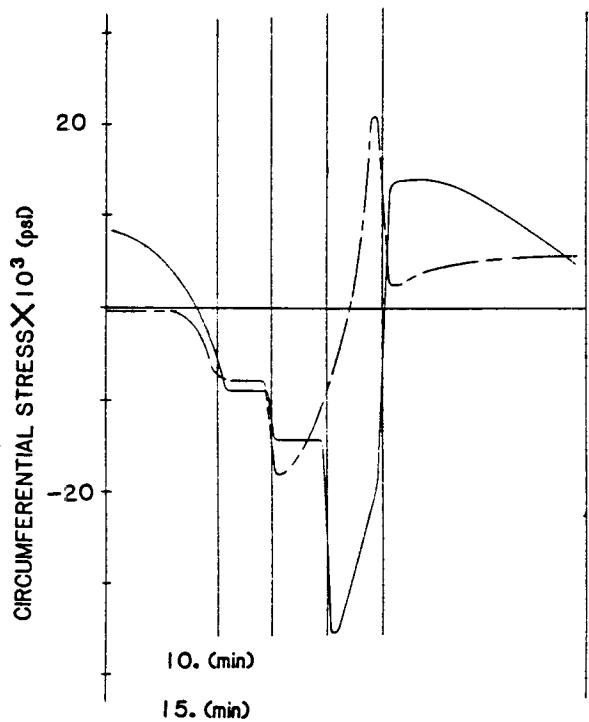
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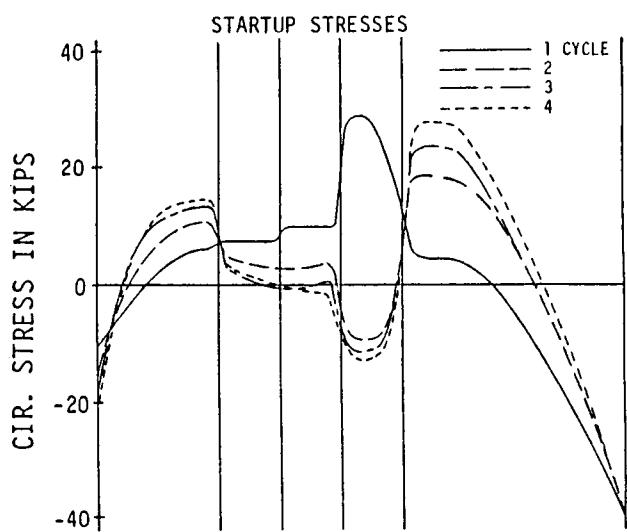
Figure 14.

Figure 15.

Figure 16.